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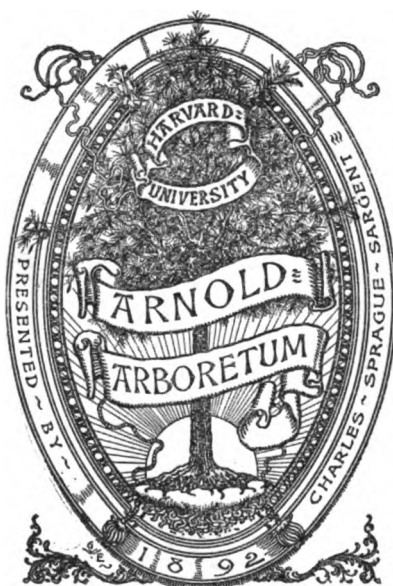
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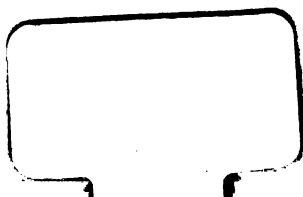
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DEPARTMENT OF THE INTERIOR—U. S. GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

THE
BITTERROOT FOREST RESERVE

BY

JOHN B. LEIBERG

EXTRACT FROM THE NINETEENTH ANNUAL REPORT OF THE SURVEY, 1887-98
PART V. FOREST RESERVES—HENRY GANNETT, CHIEF OF
DIVISION OF GEOGRAPHY AND FORESTRY



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BITTERROOT FOREST RESERVE.

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The Bitterroot Forest Reserve, situated partly in the State of Montana and partly in the State of Idaho, is divided into two unequal parts, an east and a west part, by the Bitterroot Range of mountains. The eastern section lies wholly within the basin of the Bitterroot River, in Montana; the western portion forms in part the watershed of the Clearwater, and in part that of Salmon River, in Idaho. The two sections are dissimilar both in topographic and in forestry features, and will therefore be treated separately, the latter portion in a later report.

Owing to the great area of the reserve and the limited time available, only a comparatively small section was examined. The portion traversed included, in Montana, the Bitterroot Valley within the reserve limits, except a small tract of approximately 40 square miles north of Big Hole Pass and a section of the high summits of the main range of the Bitterroot from St. Mark Peak southward about 20 miles. In Idaho the area examined included the summits of the main range for a distance of about 50 miles in length and from 5 to 8 miles in width, from the Salmon River Pass at Mineral Hill at the head of the South Fork of the Bitterroot to the head of Blodgett Canyon, and the tributaries and main canyon of Bear Creek to its junction with Magruder Fork of the Middle Fork of the Clearwater, together with a section about 20 miles in length and 8 to 10 miles in width along the latter stream; in all, about 1,650 square miles, of which 650 square miles were in the Clearwater basins and 1,000 in the valley of the Bitterroot.

In addition to the above there was examined a tract about 25 miles long and 6 miles wide in the heavily timbered portions of the main Bitterroot Valley outside the reserve, from Roaring Lion Creek to the entrance of Trapper Creek into the West Fork of the Bitterroot.

EASTERN PORTION: THE BITTERROOT RIVER BASIN.

TOPOGRAPHY.

The Bitterroot Valley is a depression sloping northward, separating the Rocky Mountains from the Bitterroot Range for a distance of 105 miles. It is drained by Bitterroot River and its numerous affluents, whose ultimate heads lie partly in the Rocky Mountains and partly in

the Bitterroots. Near the city of Missoula the river forms a junction with other streams coming from the east, and flows thence northward under the name of Missoula River to its outlet in the Clarks Fork of the Columbia. About 6 miles south from the point where the Bitterroot River loses its identity in the Missoula it receives its first large affluent, the Lolo Fork, a stream which heads in the Bitterroot Range on the northern slopes of St. Mary Peak. Thence southward for a distance of about 62 miles numerous tributaries enter the river, mostly from the west. They are nearly all small, though in the aggregate their volume of water is considerable. About 9 miles south from the village of Darby, or 68 miles from its junction with the Missoula, the Bitterroot River divides into two large forks, the East and the West forks. The East Fork, as to its principal stream, lies outside the reserve, with the exception of a small portion of the crest of the ridge along its western watershed. It heads in the Rocky Mountains and has a greater length than the West Fork. The latter stream continues from the junction of the two forks for a distance of 11 miles westerly, when it again forks, one branch, the longer one, known as the South Fork, coming from the south, and the other, the smaller branch, entering from the west under the name of the Little West Fork. About 5 miles above the junction of the Little West Fork with the South Fork the former stream again splits up into two principal branches. The more southern is named the Little South Fork, while the northern is considered the principal stream and retains the name Little West Fork.

The main valley of the Bitterroot from its junction with the Missoula River to a point $1\frac{1}{2}$ miles south from the town of Grantsdale has a width of about 10 miles from the foot of Bitterroot spurs on the west side of the river to the upper terraces on the eastern slope, which has a gradual ascent and no sharp line of demarcation between the topmost terrace and the final rise to the summit of the divide. Beginning near Grantsdale, and thence to the junction of the East Fork and the West Fork, the valley contracts to a width of between 5 and 6 miles, with the eastern declivities more abrupt, a line of bluffs rising sharply from the valley to the direct slopes of the inclosing mountains, without any well-defined intermediate terraces. The valleys of the West Fork, the South Fork, the Little South Fork, and the Little West Fork are mere narrow troughs, varying at their bottoms from one-third to one-half mile in width and with well-defined terraces only along the lower 6 miles of the West Fork. Occasionally, especially in the South Fork Valley, the troughs contract and form short gorges.

The eastern and the western watersheds that form the basin of the Bitterroot are somewhat unequal in areal extent, the eastern being the larger. It, however, supplies a great deal less water to the volume in the river, owing to its greater aridity. We estimate that about four-fifths of the quantity of water discharged into the Missoula River from the Bitterroot is drained from the western watershed.



The areas of the Bitterroot drainage basin that are situated within the boundaries of the forest reserve are confined to the western portions. From St. Mary Peak, at the northeast corner of the reserve, to a point due west from the junction of the West and East forks, about four-fifths of the western watershed, exclusive of the valley trough, is within the reserve limits. The upper half of the West Fork and the entire basins of the South Fork, the Little South Fork, and the Little West Fork valleys, with a small area of the watershed of the East Fork of the Bitterroot just north from Bighole Pass, are also included within the reserve area. The aggregates of the various tracts within the watershed of the Bitterroot River covered by the reserve are approximately as follows:

| | Square miles. |
|---|---------------|
| Main Bitterroot Valley from St. Mary Peak to a point opposite junction of | |
| East and West forks..... | 400 |
| Upper portion of West Fork Basin..... | 95 |
| Little West Fork Basin..... | 155 |
| Little South Fork Basin..... | 90 |
| South Fork Basin..... | 470 |
| East Fork Basin..... | 20 |
| Total..... | 1,230 |

This gives a total equivalent to 787,200 acres.

The western summit of the Bitterroot watershed is formed by the crest of the main Bitterroot Range of mountains, lying 8 to 15 miles west of the valley trough. The range rises abruptly from the valley level, with no intermediate foothill region. It is cut at frequent intervals by long, nearly straight, boulder-obstructed canyons that extend to the main backbone of the range. The ridges between the canyons are steep, rocky divides, usually with peaked and saw-toothed crest lines, presenting bold fronts to the main valley and inclosing the side canyons with high, often precipitous, walls in many localities, without soil or vegetation, and with slopes covered by masses of slidden rock. These features are constant from St. Mary Peak, at the northeast corner of the reserve, to the head of Little West Fork. Owing to a change in the rock formation here, the spurs and ridges assume a different aspect. The gulches are shorter, the hill slopes are less steep, more rounded, with broader crest lines, and lack the masses of slidden rock and numerous precipices that characterize the range farther north. The crest of the main divide north of the head of the Little West Fork is exceedingly rocky and tortuous. Like its eastern spurs, it abounds in precipices, rock slides, and rugged peaks, with but a very sparse growth of vegetation, and is often wholly bare. By reason of its generally greater height these features are of larger proportions than is the case with the side spurs. At intervals it is pierced with passes affording egress from the east to the west or vice versa. The passes are low saddles in the ridge where two or more streams head and flow in opposite directions, and are found at the head of nearly all the larger canyons. The summit of the ridge varies in altitude from 6,000 feet in the saddles

to 10,000 feet above sea level on the highest peaks. The greatest elevations are St. Mary Peak, in the northern portion, and El Capitan, or Gunsight Peak, in the central region of the range. The altitude of the former is approximately 9,900 feet and of the latter 10,100 feet above sea level. The summit line is not continuously passable for pack animals, nor for men on foot, owing to its rocky and precipitous nature. South from the head of the Little West Fork the divide is lower, seldom rising above 7,000 feet above sea level. It is also much broader along its crest line, is less winding and tortuous, and can be traveled with comparative ease.

The slopes that form the eastern watershed of the Bitterroot Basin rise with a low angle and more or less terraced sides for the first 55 miles southward. Above Skalkaho Creek, near Grantsdale, the slope becomes much steeper. The crest line lies about 30 miles east of the valley, but as a continuous ridge is scarcely so definite and well marked as the summit of the western watershed. The ultimate divide is the main range of the Rocky Mountains, but the intermediary ranges, radiating in all directions, form so many separate divides that the central backbone, which only touches the valley near its southern extremity, is lost sight of. The canyons that enter the valley from the east are not so numerous nor so regularly arranged as are the western affluents. The divides between them rise from the valley with easy gradients, presenting fronts many miles in width that are seamed and scarred with shallow, steep, and irregular gulches, sometimes cutting back several miles in the fronting portion of the spur.

The divide between the two principal forks of the river—the East and the West, with the South Fork extension of the latter—is a northward-projecting spur originating at the topographical point of junction of the Bitterroot and Rocky mountains. In its general arrangement of canyons and slopes it resembles the eastern watershed of the basin above Grantsdale, but has a rocky crest line, and the summit slopes are bestrewed with numerous boulder slides.

Aside from its varying width the valley of the Bitterroot throughout its length presents one general aspect, merely modified here and there to a greater or less extent by ordinary river erosion. Like many of the valleys constituting the Columbia River watershed, it appears to have been at one time a depression holding a lake, or, rather, an arm of a much larger lake lying to the northward which covered to a large extent the present head of Clarks Fork of the Columbia River Basin. A vast mass of transported material—sand, gravel, and large and small boulders—was deposited over the bottom of the Bitterroot Lake. Glacial action, especially in the Bitterroot Range, was an active factor in bringing down this débris and in cutting out the remarkable canyons that seam the slopes of the western watershed. The existence of the lake was probably due to a blocking of the valley trough of Clarks Fork by ice masses sliding into it from the adjacent mountains. When the glacial barriers were removed, drainage of





the lake occurred. Since then the stream has cut into, and in some places through, the superficial deposits of gravel and bowlders, and while doing so has shifted its flood plain back and forth across the valley. The result is a succession of benches in the wide portions of the valley, and in the lowest, or flood terrace, a large number of closed bayous or abandoned channels. Some of these old channels have in process of time been filled with deposits of loam and mold and are good meadow and agricultural lands; others are areas of springs and mud or semi-stagnant water; still others are filled with masses of liquid ooze covered with close and tough turf, to which the mere pressure of a human footstep imparts an undulatory movement, but which nevertheless possess sufficient tenacity to sustain the weight of grazing animals.

GEOLOGY.

The Bitterroot Range from the north line of the reserve to the head of the Little West Fork is composed exclusively of various modifications of granite rocks. The eastward-projecting spurs are in general of similar composition. Some small areas of gneissoid rocks occur on the eastern slopes of St. Mary Peak and from this point for a few miles southward near the valley level. The granites are extremely hard, but nevertheless much and deeply fissured in all directions. South from the head of the Little West Fork the rock formation undergoes an entire change. The granites are replaced by great masses of quartzites and felsitic rocks, extensively diked by intrusions of andesite, trachyte, rhyolite, diorite, and the like. The change is very abrupt, and owing to the softer texture of these rocks as compared to the granites of the main range farther northward, we have the general lowering of the topographical asperities already alluded to. Considered from a geological standpoint the Bitterroot Range and the Rocky Mountains coalesce where the geological formations change, and not where the topographical union is indicated. The character of the rocks and their age from Bighole Pass to the head of the Little West Fork ally them with the geology of the Rocky Mountains in this region and not with the Bitterroots. As a sequence to the view here advanced the section of main divide between the two points designated above is in reality merely a northward-projecting spur from the Rocky Mountains. The rocks of the basins of the Little South Fork and the South Fork also belong to the Rocky Mountain formation.

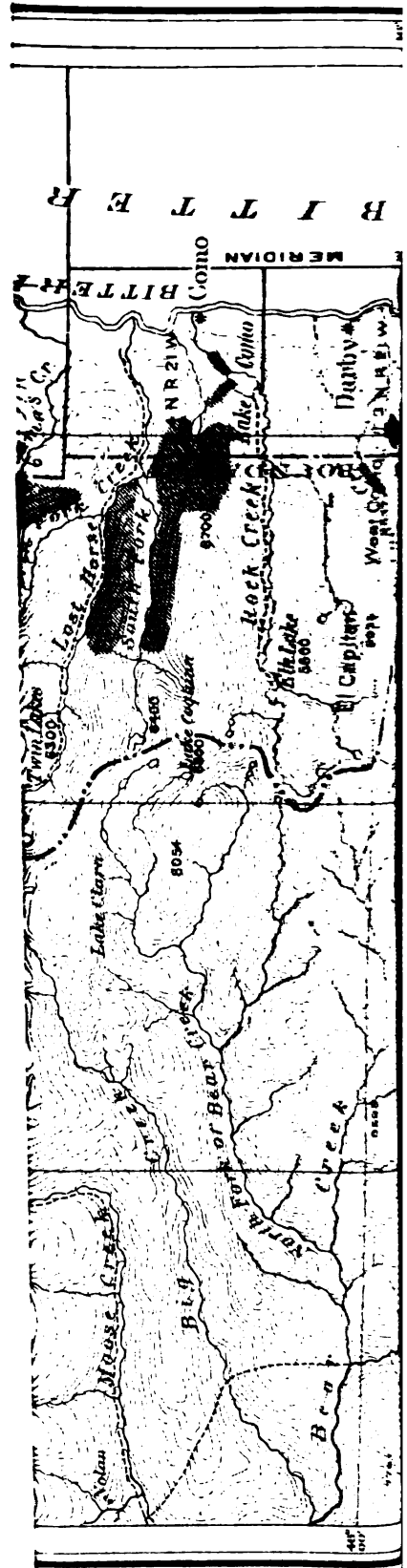
WATER SUPPLY AND ITS UTILIZATION.

Throughout its entire extent, below elevations of 5,000 feet above sea level, the valley of the Bitterroot must be classed as an arid region so far as agricultural operations are concerned, notwithstanding the fact that large areas below this height support a heavy growth of forest. However, as soon as the timber is cleared away and tillage of the ground

commences aridity is the consequence, and artificially supplied moisture becomes necessary to the production of crops. The only areas where an exception to this rule occurs are the filled-in bayous or old river channels in the present flood terrace. There are varying degrees of aridity as between the different sections of the valley. The northern portion is most conspicuous in this respect, and of the two halves the section east of the river is much the drier. The proximity of the high main range of the Bitterroot is the chief cause of the lessened humidity in the valley to the east. Precipitation comes principally from the south and southwest, and the range stands in the way of free circulation of air. It intercepts the greater portion of the humidity, compelling condensation and precipitation along its crest and summit slopes, and permits but a fraction to pass over into the valley. The precipitation on the range and its spurs occurs mostly as snow. No reliable data are obtainable regarding the greatest depth of the winter's accumulation. The statements of persons that have crossed the main divides in early spring, when we may assume the greatest depth, are conflicting. It would appear, however, that it is not less than 12 feet for the divide between St. Mary Peak and the head of the Little West Fork at elevations of 6,000 feet above sea level, nor less than 5 feet from the head of the above-mentioned stream to Bighole Pass. How large a quantity of water in inches this represents is not known. The aspect of the timber growth at elevations of 6,000 feet, as compared with forests composed of similar species where the yearly precipitation is approximately known, would indicate about 60 to 65 inches as the average for the year along the main divide north of the head of the Little West Fork, and from 35 to 40 inches for the section south to Bighole Pass. Precipitation in the valley is probably nearly equally divided between rain and snow. About 10 to 15 inches of water is the average for the northern portion of the valley. More falls in the southern areas, but never enough to suffice for the production of crops. Although reaching considerable elevations, there is no universal snow line on the Bitterroot Range. There is one on the east and north slopes on peaks above 8,000 feet elevation, but, in general, by far the greater portion of the winter snows melts between late spring and the ensuing fall. Owing to direction of exposure, longer slope, and less precipitation, the eastern watershed has no permanent snow line in any direction.

The equalizing factors in the distribution of the season's precipitation from the western watershed of the basin are as follows:

- (1) The topographical configuration around the head of the main-range canyons and their smaller laterals.
- (2) The amount of fissuring that the rocks along the canyons and at their heads have been subjected to.
- (3) The rapidity with which the snow is melted and the resultant discharge of water into the streams.
- (4) The rapidity of the flow from the higher to the lower levels.





The topographical features at the head of the canyons originating in the main range present two aspects. In the granite portion they have usually as their ultimate heads flat, marshy expanses, or small lakes excavated in the main divide, in the larger spurs, or in both. The marshy tracts usually hold one or more lakelets, which in the past were much larger, but have been gradually reduced by the wearing away of the rock barriers at the outlets. They are covered with a close, thick turf of alpine grasses and sedges, and often have small copses of trees scattered over their areas. Where forest fires have not penetrated they are surrounded with a dense fringe of the subalpine forest. Along the margin where the fringe of forest joins the grassy area is the spring level. Innumerable springs issue along this margin, discharge into the lakelet of the basin, and assist in maintaining the stage of water in the stream whose head they form. The springs represent the seepage from the surrounding heights. Sometimes the lake or pond has been drained by the complete wearing away of the outlet barrier, the springs discharging into one or more sluggish streams that meander through the meadow. Sometimes, but rarely, the meadow is lacking, and the springs issue into a lakelet situated in a hollow scooped out in the naked granite. Marshy tracts and lakelets similar to those described are sometimes found, not only at the heads, but also in the middle and upper portions of the canyons. All these areas form a natural reservoir system which is one of the main regulators in the flow of water from the Bitterroot canyons, and as such is of the greatest importance. The lakelets and marshy expanses are lacking in the portion of the watershed south of the head of the Little West Fork. Other factors of the four we have indicated are there present, however, in greater force, and make up for the deficiency of the other.

On the amount of rock fissuring depends the quantity of water that will sink upon the higher slopes within a given time and issue at lower levels as springs. The rocks of the granite areas of the Bitterroots are extensively and deeply shattered, and the slopes are widely littered with rock slides composed of boulders, large and small, the interstices more or less filled with coarse gravel, sand, or clay. The rock slides are good conservators of the water flow, and supply largely the natural deficiency in the subalpine forest growth which exists in the higher regions. Beyond the granite areas in the upper portion of the Bitterroot Basin the fissuring and the rock slides have not been so extensive. The dikes of eruptive matter have, however, shattered the solidity of the adjacent bed rock in various localities and created underground waterways from which feeders issue that assist in maintaining the water level in the streams.

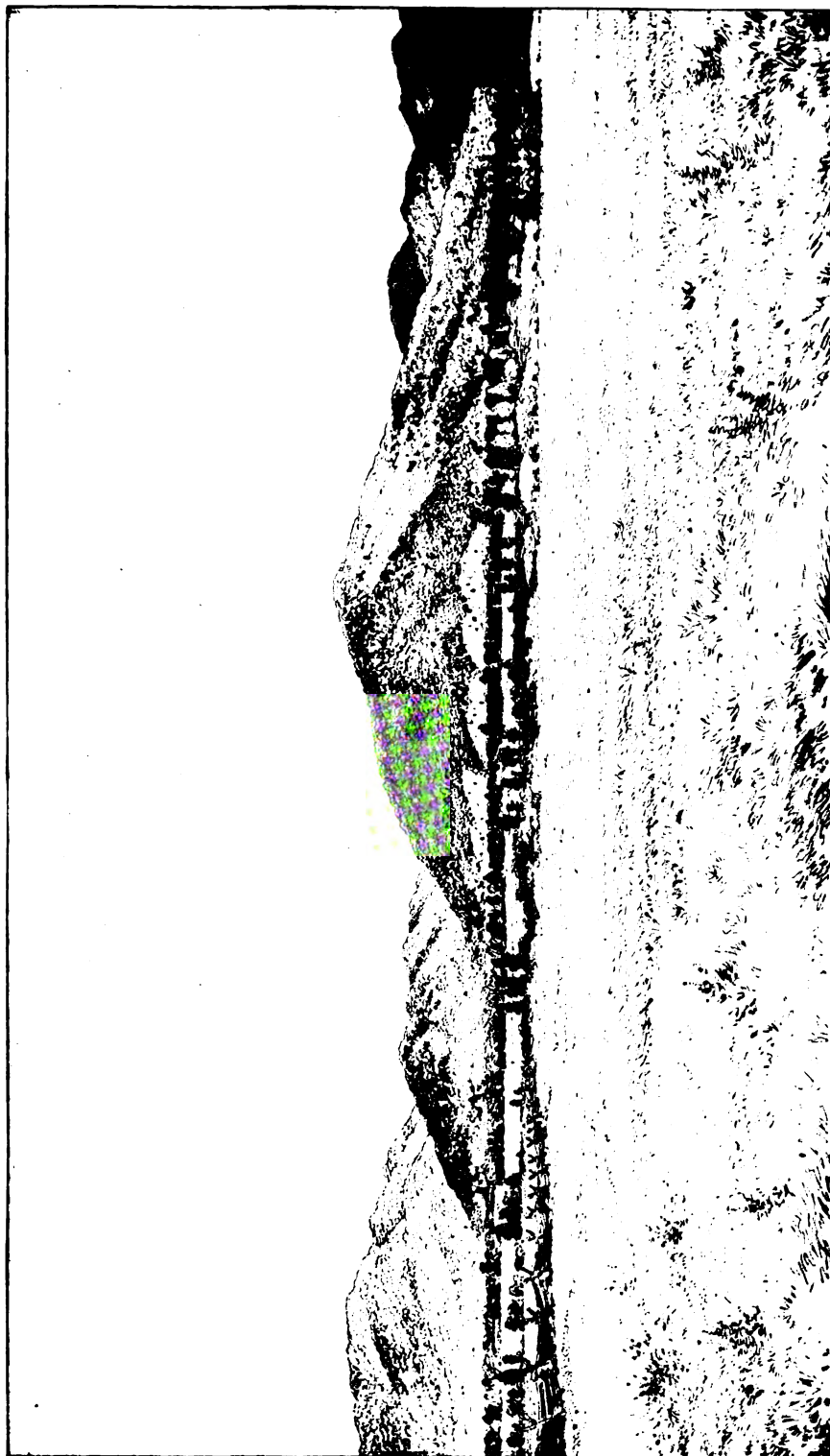
Considering the elevation at which it lies, the snow in the Bitterroot Range melts rapidly. The large areas along the upper slopes devoid of forest give the sun and wind free access, and the numerous precipices

upon whose sides no snow can lodge reflect the sun's heat on the snow banks that adjoin them and hasten the melting process. Were the bed rock less fissured, or did not the basin reservoirs exist, vast quantities of water from the rapidly melting snows would be suddenly precipitated every spring into the valley below, bringing with it the débris of boulders and sand torn out and ground down from the mountains. The fall throughout the canyons of the granite sections of the Bitterroots is very considerable, amounting in many cases to 300 or 400 feet a mile, and for short distances even more. It is not uniform, however, being interrupted at various points by flat, marshy tracts. The torrential force of the water capable of being engendered by such rapid descents is largely counteracted by the vast boulder accumulations in the stream beds. Yet, if the water-retarding influences along the canyons and at their heads were interfered with to any great extent, there is scarcely a doubt that the spring volume of water would be sufficient to sweep the boulder masses into the main valley.

The factors that control the water distribution through the canyons of the Bitterroot Basin south of the Little West Fork are an abundance of forest growth and slight fall in the streams. The former is the more potent, as it prevents too free circulation of warm air and screens the snow banks from the direct rays of the sun and too rapid melting. In this section there is also much less precipitation than on the watershed farther northward.

The canyon system of the western watershed is remarkable in the paucity of laterals received by the main streams. The explanation is found in the short transverse basal diameters of the dividing spurs, which make impossible the existence of long side canyons. Instead each canyon from its point of discharge into the main stream to its head in the Bitterroot Range is a sort of fairly regular and straight sluice box, receiving but a few short affluents from each side, but dividing near its head into several branches. In the range north of the Little West Fork these branches are often of considerable length, made possible by the great westward retreating angles of the main divide.

The volume of water in the main Bitterroot River is almost wholly dependent on its canyon affluents, and varies accordingly. The only accessions from other sources, rain and snow in the valley trough excepted, come from the springs that burst out along the terrace slopes at various points. They are numerous at certain places, as between Roaring Lion and Lost Horse creeks, and less common farther south. Some are quite circumscribed, while others cover areas of 15 to 30 acres, and give rise to small creeks, that occasionally carry a sufficient volume of water to make them valuable for irrigation purposes. The springs owe their origin to the accumulated drainage that flows from the front of the mountain spurs abutting on the valley. In its downward flow to the main river through the mass of glacial detritus, hidden obstructions, such as ledges of rocks or impermeable beds of



BITTERROOT VALLEY NEAR GRANTS DALE. LOOKING WEST.

clay, are encountered, the water is forced to the surface, and springs result.

For purposes of irrigation water is taken from the main river and from the lateral tributaries. Only a fraction of the volume in the main stream is utilized at present. The terraced formation of the valley offers great obstacles to extensive irrigation by means of water taken from the river. The upper terraces below the main forks are elevated from 300 to 700 feet above the flood level, and to reach them with water from the main river would require the construction of miles of expensive ditches from near the ultimate heads of the streams. Most of the lands in the Bitterroot Valley are irrigated by water taken from the side canyons. The volume carried by them during the growing season is wholly insufficient to meet the possible demands, and in consequence large tracts of arable land are untilled. Nearly all the canyons of the western watershed offer good opportunities for the creation of small storage reservoirs. There are no physical difficulties in the way of constructing retaining dams at the head of the streams and turning the subalpine meadows into lakes. Many localities along the central portion of the canyons between the stretches of rapid descent present similar opportunities for easy damming of the streams, and most of them are narrow enough at their point of debouchure into the main valley to afford possibilities for the erection of storage dams to hold back limited quantities of water.

West of Como post-office, at the mouth of Rock Creek, Como Lake forms a natural storage basin. By a dam at its outlet this could be readily enlarged to several times its present volume.

Dams to hold back a portion of the surplus water have been constructed in Mill and Big creeks, two streams heading in the Bitterroot Range. Their construction, which is on a small scale, has been a matter of local enterprise. So far as it goes the work has been entirely successful. The enlargement of the irrigated area in the western half of the Bitterroot Valley will unquestionably depend upon the conservation of water that now originates in and flows from the watershed within the reserve limits. The heads of these streams lie at such a height and the fall is so rapid that, given a sufficient volume of water, even the highest terraces can be reached by means of comparatively short ditches. The eastern side of the valley is not so favorably situated for irrigation from the lateral affluents of the Bitterroot. The long slope has facilitated the excavation of deep gully-like channels through all but the lower terrace, and in addition, owing to a diminished precipitation, many of the streams are mere dry runs during the growing season.

There are no data obtainable regarding the volume of water discharged by the Bitterroot into the Missoula River. Its volume varies much in different sections along its course. There is evidently an enormous underflow through the loose and porous subsoil, and the

abandoned and partially filled bayous absorb large quantities, thereby setting up an extensive side flow.

The current in the main river, on the average, is rapid, but is far from uniform. It varies from one-half mile in short, slack-water spots to 4 or 5 miles an hour, or even more on the ripples. The aggregate amount of fall from the upper portion of the South Fork to the point where the river discharges into the Missoula is about 1,600 feet and from the summit at the head of the same fork about 2,800 feet.

SOIL CONDITIONS.

The surface soil of the valley is of a light sandy or gravelly composition in some localities, especially on the east side of the river, and on the flood terrace it is more or less mixed with clay. The subsoil is composed almost wholly of sand, gravel, and boulders, rarely of beds of clay. On top of this subsoil rests a layer of loam and mold from 1 to 2 or more feet in thickness. The flood terrace has the deepest soil, as it is largely made up of old river channels which have been filled with thick deposits of vegetable debris. The upper benches possess the lightest soils. Boulder-strewn tracts covering from 50 to 1,000 acres are met on both the upper and the lower terraces throughout the entire extent of the valley. The soil of the mountain slopes is merely a thin layer of mold resting on coarse granite detritus. The bottoms of the canyons are exactly similar, but have a heavier covering of topsoil, due to the washing in from the slopes above. The subalpine meadows have a subsoil of purely granite gravel, with the mold and loam varying from 6 inches to 6 feet or more in depth. The greatest accumulations occur in sphagnous bogs that are common around the margins of the lakelets in those meadows.

AGRICULTURAL LANDS.

The agricultural lands in the Bitterroot Valley below the main forks are, in effect, all lands upon which water can be brought. Within the reserve limits there are no agricultural lands from St. Mary Peak, at or near the northeast corner of the reserve, to the point where the east boundary line crosses the West Fork, near Boulder Creek. The entire area between the east boundary line and the summit of the Bitterroot Range is a mass of rugged, sharp peaks, saw-tooth crested spurs and ridges, steep or perpendicular mountain slopes, and rocky, boulder-obstructed canyons.

The agricultural lands within the reserve limits are situated in the valleys of the South Fork, Little South Fork, Little West Fork, and West Fork, and are of two kinds:

1. Tracts on which the timber has long been cut and which are now under the plow.
2. Areas along the streams, covered with a growth of brush, willows, or coarse sedges, and having occasional small patches under the plow.



A SUMMIT OF THE BITTERROOT RANGE AT NEZ PERCES PASS.



B MAIN RANGE OF THE BITTERROOT MOUNTAINS, LOOKING NORTH FROM NEZ PERCES PASS



A. SUMMIT OF THE BITTERROOT RANGE NORTH OF LOST HORSE PASS SEEN FROM BIG SLIDE IN LOST HORSE CANYON



B. SUMMIT OF BITTERROOT RANGE, LOOKING SOUTH FROM NEZ PERCES PASS, CROWN PEAK IN THE NEAR BACKGROUND.

Lands of class 1 are found in the Little West Fork and West Fork valleys. The amounts are as follows:

| | Acres. |
|---|--------|
| Little West Fork at its junction with South Fork..... | 45 |
| Near Prickett Creek, West Fork Valley..... | 10 |
| Total | 55 |

These holdings are included in three squatter claims, with an aggregate of 480 acres. Hay is the principal crop obtained from the tracts under cultivation. Besides these claims, on which a fairly constant residence is maintained, there are a great many others marked only by dilapidated cabins and decaying fences. They were originally taken as squatter claims, and were abandoned as soon as the timber growing on them was cut and disposed of. In only a single instance is present residence maintained on any of them, namely, at the junction of South Fork and Little West Fork. No portion of this claim, however, is under the plow.

The lands in class 2 are situated in the valleys of the Little South Fork and the main South Fork. Their approximate distribution is as follows:

| | Acres. |
|--|--------|
| In the upper half of Little South Fork Valley | 200 |
| In South Fork Valley below and including Rambo Flat..... | 150 |
| In South Fork Valley from Slate Creek to Overwhich..... | 250 |
| In South Fork Valley between Overwhich and Hughes Creek..... | 150 |
| In Overwhich Valley..... | 120 |
| In Hughes Creek Valley | 350 |
| In Wood and Chicken creeks..... | 100 |
| In South Fork Valley at Mineral Point | 120 |
| Total | 1,440 |

Of this, the amount under cultivation is approximately as follows :

| | Acres. |
|---|--------|
| In the valley of Little South Fork..... | ... |
| In the valley of main South Fork..... | ... |
| Below Overwhich..... | 5 |
| At Overwhich | 20 |
| Above Overwhich..... | 2 |
| Total | 27 |

The agricultural lands of class 2 are nearly all occupied by parties maintaining a residence on their several claims. About 12 holdings, embracing 1,920 acres, cover the lands of this class. Owing to lack of surveys the claims have no legal boundaries, and their sides and end lines as staked out do not form right angles, but pursue zigzag courses following the valley contours and excluding the hillsides.

The aggregates of the agricultural lands within the reserve in the Bitterroot Basin are therefore as follows:

| | Acres. |
|---|--------|
| Little West Fork and main West Fork basins..... | 55 |
| Little South Fork and main South Fork basins..... | 1,440 |
| Total | 1,495 |

Land actually under cultivation:

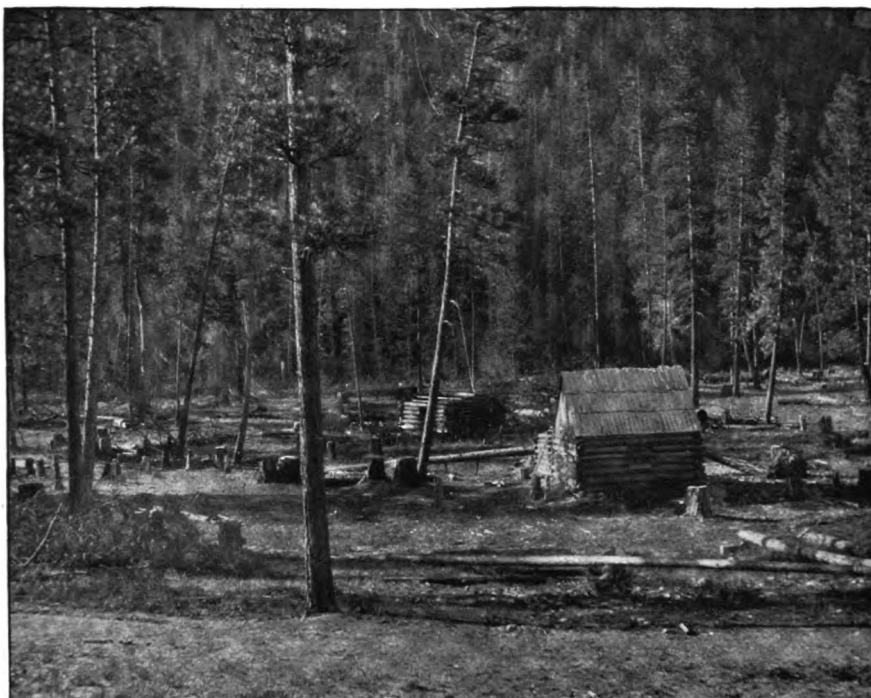
| | Acres. |
|--|--------|
| Little West Fork and main West Fork basins | 55 |
| Main South Fork and Little South Fork basins | 27 |
| Total | 82 |

The valley troughs of the South Fork and Little West Fork have two low terraces. They are not continuous and are found principally in the lower half of their valleys. The agricultural claims lie on the lower terrace. The upper is always rocky or littered with drift boulders, and is not suitable for agricultural operations. The valleys in which these lands lie are frosty. They are above the 4,000-foot level and, receiving the cold draft from the great canyons that open up to the main divides every 2 or 3 miles, are liable to a freeze at night any time during the growing season. The small area under cultivation is mostly seeded to timothy, a few very limited patches producing an uncertain and inferior crop of potatoes and the hardiest common vegetables.

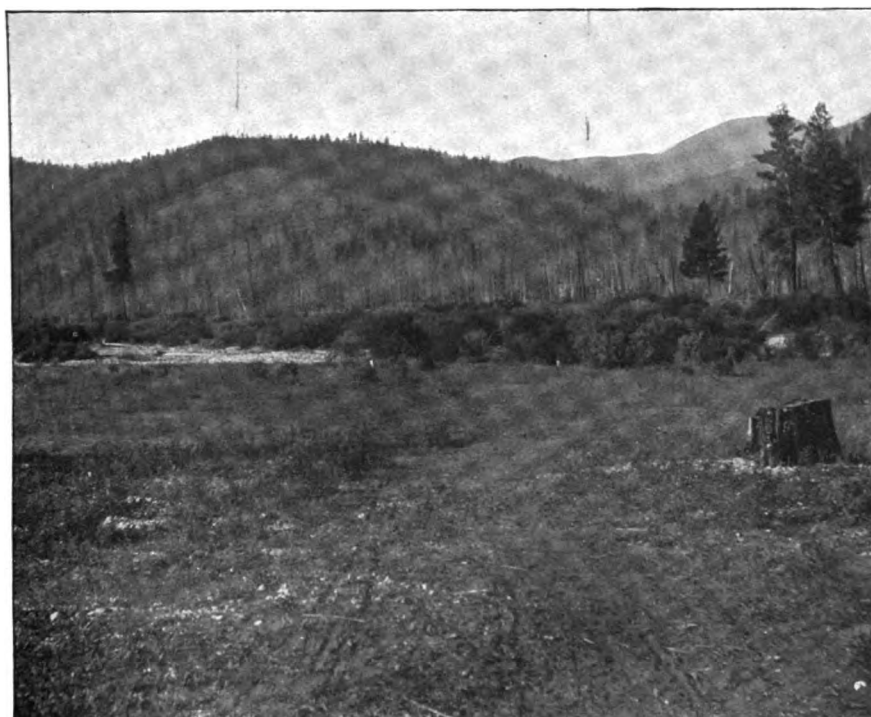
GRAZING LANDS.

The hillsides adjacent to the valleys of the Bitterroot Basin above the main forks are utilized to some extent as grazing grounds. The southern and western slopes below 5,200 feet elevation usually produce an open growth of timber, with the ground covered by a sward of grasses and sedges. Cattle and horses are pastured there, but no sheep. Most of the stock is owned by parties that live outside the boundaries of the reserve, chiefly in the Bitterroot Valley, below the junction of the East Fork and the West Fork, where the natural grazing is largely eaten out. No appreciable damage appears to be done by the grazing in the forest.

The proposition has been advanced by parties living in the Bitterroot Valley that the subalpine meadows at the head of the streams in the Bitterroot Range and along their courses could be utilized as hay meadows and grazing grounds. Such use of these tracts should be rigorously prohibited. We have seen what an important part they perform in the conservation of the waterflow, and how essential is the preservation of their integrity, to the end that the present balance may not be disturbed. It is not to be denied that notwithstanding the considerable altitude at which the meadows are situated they are capable of producing crops of the more hardy forage grasses. To do this it is essential that they be ditched, so as to afford a rapid outlet for the spring drainage along their margins. The effect of ditching would be to throw into the valley the season's drainage much more rapidly than now, and thus diminish still further the available irrigation water during the growing season. Grazing on the meadows, while not so liable to work mischief, is still not to be commended, as it tends in all cases to break up the existing turf and facilitate the more rapid flow of water.



A. VIEW OF A SQUATTER'S CLAIM, WITHOUT ANY CULTIVATED GROUND, ON ABANDONED LOGGING CLAIM AT THE JUNCTION OF SOUTH AND LITTLE WEST FORKS OF BITTER-ROOT RIVER SHOWING ABOUT 90 PER CENT OF THE MERCHANTABLE TIMBER REMOVED FROM THE CLAIM.



B VIEW OF AGRICULTURAL LANDS OF THE SECOND CLASS IN THE SOUTH FORK VALLEY AT OVERWHICH SHOWING BRUSH LAND IN THE BACKGROUND AND CLEARED BRUSH LAND IN THE FOREGROUND.

The big canyons of the western Bitterroot Valley watershed are a constant menace to the agricultural interests of the main valley within their influence, though it is safe to say that the people in the valley do not realize it. The descent of these canyons is so rapid and the possible drainage into them so great that any considerable disturbance of the water-retaining factors at their heads or along their courses is liable to precipitate suddenly large volumes of water into their channels when the spring break-ups occur. With their rapid descent and narrow troughs a large quantity of water would readily gain sufficient force to sweep the great talus accumulations in their beds out upon the agricultural lands in the valley. For this reason no interference with existing conditions along these streams should be permitted, except such as have for their object an increase of forest growth or artificial retardation of the water flow through damming operations.

MINERAL LANDS.

The Bitterroot Range is deficient in mineral-bearing areas throughout the granite sections. Indications of such deposits have been discovered from St. Mary Peak southward to Big Creek, but none of the claims so far located have been opened up sufficiently to disclose their true character, with the exception of the Curlew claim, situated due west from the small village of Victor. None of the claims are inside the east boundary of the reserve. South of the granitic regions of the range there appears to exist a well-mineralized belt. The entire basins of the Little West Fork, Little South Fork, and South and West forks constitute the Overwhich mining district. The recorded claims in the district are mainly confined to the South Fork Basin. A single claim on the Little West Fork covering a mineral spring was the only one observed elsewhere in the district.

The claims in the South Fork Valley are scattered throughout its length. Many are located on Slate Creek, others between Slate and Overwhich, a number in the valley of the latter. The bottom of Hughes Creek is a compact mass of placer claims for nearly its entire length. The greatest number of lode claims exist above Mineral Point. Collectively there are probably several hundred such claims in the district. No lode claims have been opened up sufficiently to show permanent values. The placers along Hughes Creek are worked intermittently and are said barely to pay the expenses of working. On Coal Creek, a small stream emptying into the South Fork directly opposite Overwhich, deposits of coal occur. They are found in the north-central portions of the valley, are covered with a swampy lodgepole-pine forest, and comprise about 500 acres. The coal is of Tertiary age, but through great pressure has acquired a semi-bituminous texture. It is free from sulphur, so far as known, and burns freely. Two seams have been discovered, the upper one with a thickness of 12 feet, while the extent of the lower

is unknown. Two claims, each of 160 acres, are maintained on this deposit. Coal lands very probably occur also on Bluejoint Creek, the next stream northward from Coal Creek that enters the South Fork.

FOREST ZONES.

Two forest zones are represented in the Bitterroot Valley—the yellow-pine and the subalpine-fir zones. Of the 787,200 acres, which it is estimated represent the area in the Bitterroot River Basin within the reserve, about 26 per cent, or nearly 205,100 acres, belong to the zone of the yellow pine, and 74 per cent, or about 582,100 acres, to the zone of the subalpine fir.

The acreages in these estimates may be found to need correction when accurate surveys have established the absolute area, but the percentages are substantially correct. In the estimate of the subalpine zone the areas high enough to come within a truly alpine classification are also included. The yellow-pine zone is distributed as follows:

| | Square miles. |
|---|---------------|
| Main Bitterroot Valley from St. Mary Peak to a point west of and opposite to the junction of East and West forks, 7.5 per cent of 400 square miles .. | 30.00 |
| Upper portion of West Fork Basin, 20 per cent of 95 square miles | 19.00 |
| Little West Fork, 15 per cent of 155 square miles | 23.25 |
| Little South Fork, 44 per cent of 90 square miles | 39.60 |
| South Fork, 44 per cent of 470 square miles | 206.80 |
| East Fork, 9 per cent of 20 square miles | 1.80 |
| Total | 320.45 |

The altitudinal limit in this region of the yellow-pine zone is about 5,800 feet above sea level. In the portion of the reserve north of the West Fork it occupies the slopes that face directly south or east and those that front on the valley up to the above elevation. In the canyons it extends from 2 to 3 miles above their outlet into the main Bitterroot Valley. In the basins of the West Fork and South Fork, with their lesser tributaries, it occupies the south and west facing slopes, and also those with a northern and eastern exposure to elevations of 4,800 to 5,000 feet. It extends in the bottoms of these valleys and side canyons in more or less continuous blocks to within 2 to 5 miles of their heads. In the smaller canyons it is often lacking on the northern slopes, with the exception of a narrow, irregular belt just above the valley trough. Outside the reserve in the valley below the main forks it occupies the entire west side of the valley from the forks nearly to the mouth of Roaring Lion Creek, opposite Grantsdale, with the exception of a strip a mile or less in width. Below the mouth of Roaring Lion Creek it recedes westward to near the base of the mountains, sending out irregular lobes at intervals until the Lolo Fork is reached, when it takes a long westward sweep, conforming to the curve of the range. The largest area in the main Bitterroot Valley covered with a nearly solid and pure growth of the yellow pine lies between Roaring

Lion Creek and Trappers Creek where it empties into the West Fork, and comprises about 145 square miles, or 95,800 acres.

On the east side of the valley it fringes the tributary canyons, sometimes forming considerable bodies of nearly pure growth. On the spurs fronting the valley on this side below Grantsdale the zone is confined to a narrow belt nearly at its upper limit. Above Grantsdale it descends, with sparsely timbered hillsides and scattered groves, to the level of the valley, or nearly so. Near Stevensville two eastward-and-westward extensions of the zone meet and stretch across the valley.

The subalpine and alpine areas constitute the greater portion of the reserve in the basin. North of the West Fork they cover all slopes having a northern or direct western exposure. They also occupy the summits of the ridges and the south and east facing slopes above 5,800 feet. In the main canyons the subalpine zone begins from 2 to 3 miles back from their outlets and continues to their heads. All slopes and summits of the main range belong either to the alpine or to the subalpine zone. The lower limit of its range is indefinite, depending on water supply and exposure. Thus in the canyons the subalpine zone may descend to 4,200 feet above sea level, or 1,800 feet below the highest level of the yellow-pine on southern slopes.

The zone is less extensively developed in the valleys of the West Fork and the South Fork and their tributaries. It is here found on the summits and northern slopes above 5,000 feet elevation. It likewise occupies the wet and swampy bottoms of the canyons in interrupted belts to within 2 to 4 miles of their outlets, alternating with blocks of the yellow pine where the ground is dry or well drained. Of the entire subalpine and alpine tracts within the reserve limits in the basin, about 43.4 per cent, or 370 square miles, occur in the region north of the West Fork Basin, where the total area is estimated to contain but 400 square miles. The remainder, or 483 square miles, is distributed among the basins of the West Fork and the South Fork and their tributaries.

The areas of the subalpine zone outside the reserve are comparatively small in the west half of the Bitterroot Basin. They consist of the slopes and canyons cut off from the main body of the range by the east boundary line. On the east side of the valley the mountain summits, stretching back to the main range of the Rocky Mountains, are covered by the zone.

The species of forest trees comprising the arborescent growth in the zones are as follows:

Species of trees comprising the arborescent growth.

I. YELLOW-PINE ZONE.

| | |
|------------------------------|-------------------------------|
| Yellow pine..... | <i>Pinus ponderosa.</i> |
| Lodgepole pine | <i>P. murrayana.</i> |
| Red fir..... | <i>Pseudotsuga taxifolia.</i> |
| White fir | <i>Abies grandis.</i> |
| Balsam (balm of Gilead)..... | <i>Populus balsamifera.</i> |

FOREST RESERVES.

II. SUBALPINE ZONE.

| | |
|-----------------------|-------------------|
| Lyall tamarack..... | Larix lyallii. |
| Subalpine fir..... | Abies lasiocarpa. |
| Lodgepole pine..... | Pinus murrayana. |
| White-bark pine..... | P. albicaulis. |
| White fir..... | Abies grandis. |
| Engelmann spruce..... | Picea engelmanni. |
| Yew..... | Taxus brevifolia. |

The relative proportions in which these species occur are about as follows:

Relative proportions of species.

I. YELLOW-PINE ZONE.

| | Per cent. |
|---|-----------|
| Yellow pine..... | 30 |
| Lodgepole pine..... | 6 |
| Red fir..... | 60 |
| White fir..... | 2 |
| Balsam (balm of Gilead)..... | } . 2 |
| Aspen..... | |
| Semi-arborescent willows and other species..... | |
| | 100 |

II. SUBALPINE ZONE.

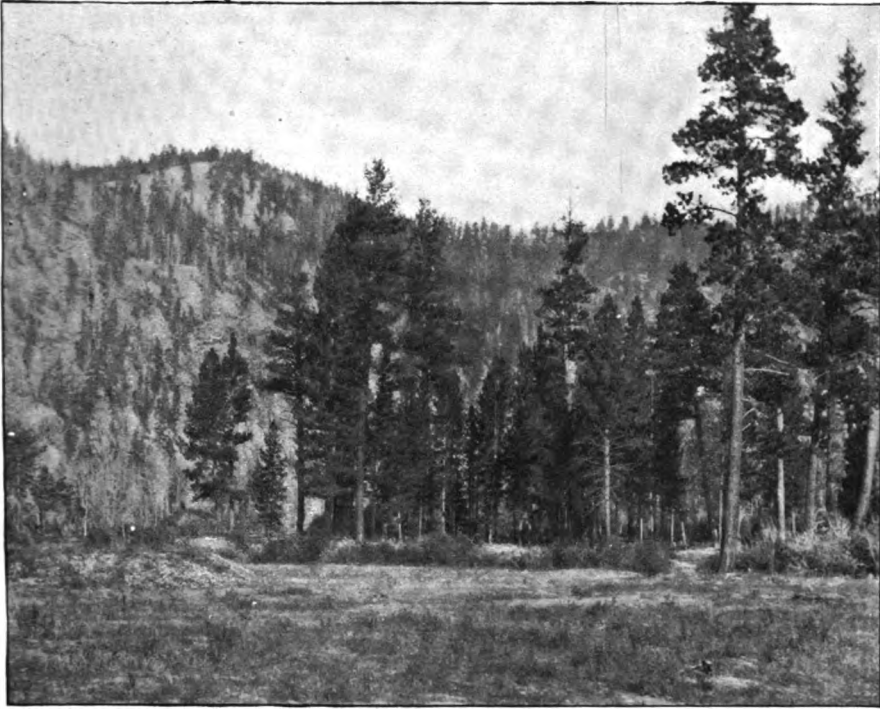
| | |
|---------------------------------------|-----|
| Subalpine fir..... | 5 |
| Lodgepole pine..... | 90 |
| White-bark pine..... | } 5 |
| Lyall tamarack..... | |
| White fir..... | |
| Engelmann spruce..... | |
| Yew and semi-arborescent willows..... | |
| | 100 |

These estimates are based on trees having basal diameters above 4 inches.

The species utilized for lumbering (logging) purposes are confined to those that grow in the yellow-pine zone, and practically to yellow pine. Other trees—yellow pine, lodgepole pine, red fir, white fir, balsam (balm), and aspen—are used only to a trifling extent. For other purposes, such as posts, fencing material, mining timbers to be used on the ground where the trees grow or immediately adjacent, the proportion is about as follows:

| | Per cent. |
|---------------------|-----------|
| Yellow pine..... | 30 |
| Lodgepole pine..... | 50 |
| Red fir..... | 20 |
| White fir..... | -- |
| Balsam (balm)..... | -- |
| Aspen..... | -- |
| | 100 |

None of the subalpine species are utilized except the lodgepole pine, which is used by the miners in their prospect tunnels and shafts for lagging, when the workings are situated so high that no other species is available.



A. YELLOW-PINE FOREST NEAR OVERWHICH, ON SLOPES FACING WEST.



B. LODGEPOLE-PINE FOREST AT THE HEAD OF COAL CREEK, IN THE SOUTH FORK BASIN.

RANGE IN SIZE AND AGE OF TREES.

YELLOW-PINE ZONE.

The variation in size of the yellow pine is more in the direction of the height of the clear trunk than the diameter. At its uppermost limit of 5,800 feet many individuals occur with diameters fully equal to those at lower levels. The clear trunk, however, is deficient in length, often not measuring more than 6 to 8 feet from the ground to first branches of distinctive crown. Within the reserve limits the most valuable growths of the species are found between elevations of 3,700 to 4,800 feet above sea level. The best-developed individuals occur in the bottoms of the largest valleys and on hill slopes with a fair depth of soil and moderate seepage. In the main Bitterroot Valley outside the reserve limits the tree attains its greatest stature and density on the terraces above Grantsdale, on the west side of the river, between elevations of 3,600 to 4,200 feet. On the dry hill slopes throughout the basin above altitudes of 4,800 feet it is usually much scattered and dwarfed in stature.

Nearly always, wherever found in the basin, the hemlock-spruce is undersized. It is near its eastern limit in this latitude, and the annual precipitation, together with the natural poverty and shallowness of the soil, greatly modify its growth. It is never found to equal, in any degree, the species as it occurs west of the Bitterroot Range. Its largest dimensions are reached on the more humid areas of the bench lands in the main valley and in the bottoms of the West Fork. It occurs most abundantly on those slopes in the yellow-pine zone that face northward in the West Fork, Little South Fork, and main South Fork valleys. On such slopes there is not one individual in a thousand that forms a distinct, clear trunk. The permanent crown usually begins within 2 or 3 feet of the ground and persists throughout the life of the tree. It is owing to its small size that the tree is not more extensively logged. It yields otherwise a class of material that is far more durable in underground mining operations than the yellow pine now employed.

The lodgepole pine, as it occurs in the yellow-pine zone, is of small growth and is found in circumscribed patches where the original growth of red fir has been burned off. The white fir is also commonly an undersized tree. Outside the reserve limits, however, in the main Bitterroot Valley, it sometimes attains a height of 100 feet or more, with diameters of 2 to 3 feet. The balsam, or balm of Gilead, and the aspen are both small and insignificant trees in the upper portion of the basin. Along the Little South Fork the aspen occasionally forms copses of nearly pure growth over areas of 10 to 20 acres. On the banks of Bitterroot River, below the forks, the balsam poplar becomes a good-sized tree, reaching a height of 60 to 70 feet, with diameters varying from 2 to 3 feet.

SUBALPINE ZONE.

The trees of the subalpine zone are generally deficient in development of clear trunks. The subalpine fir, white fir, and Engelmann spruce usually retain permanent living branches to within 4 or 5 feet of the ground at elevations of 6,000 feet and upward. The Lyall larch and white-bark pine occasionally acquire a good trunk development with age, while the lodgepole pine rarely is more than a mere pole. The density of the subalpine forest varies with the species comprising it. On the high summits of the range north of the head of the Little West Fork the subalpine fir, Lyall larch, and white-bark pine form open, scattered growths separated by wide expanses of nearly bare areas. In the canyons Engelmann spruce, white fir, and lodgepole pine mingle with the subalpine fir and form forests of considerable density. Above the zone of the yellow pine and extending to about 6,500 feet elevation there is often found an excessively close growth of lodgepole pine. It is especially well developed at the head of all the canyons that enter the Bitterroot Basin south from the head of the Little West Fork and on the broad front of the spurs that face the main Bitterroot Valley. The growth is a replacement of an older forest of subalpine fir and white-bark pine burned off a hundred or more years ago. The charred remains of the previous forest are found abundantly throughout the lodgepole-pine growth and give certainty on this point. The lodgepole-pine areas are the most characteristic in the subalpine zone. The closeness of the growth is very striking. The trees frequently stand so close that it is difficult for a man even on foot to force his way between them. The individual trees are always of slender growth, but of no great height, and the majority of them are short lived.

AMOUNT OF STANDING TIMBER.

YELLOW PINE.

The estimates for standing living timber on the reserve are based upon measurements of 16 inches and upward, basal diameter, for yellow pine and 8 inches and upward for red fir. Much the greater portion of the red fir is contained between diameters of 8 and 16 inches at the butt. Yellow-pine trees that will make saw logs 10 feet in length are included, and all red fir above the specified diameter, whether with a clear trunk or otherwise. A great deal of the yellow pine is defective, owing to resin cracks and partially barked spots on the trunks. The defects are due to repeated fires. In many localities, more especially in the South Fork Basin, as many as 50 per cent of the trees are thus affected. The defective portions constitute from 6 to 10 feet of the total length of the clear log. The defective portions of the trees are excluded from the estimates when the fire sears are more than 2 feet in length.



A. YELLOW-PINE FOREST NEAR THE OUTLET OF OVERWHICH CREEK, ABOUT 700 ACRES IN THE TRACT, AVERAGING NEARLY 8,000 FEET B. M. PER ACRE.



B. YELLOW-PINE FOREST IN THE BITTERROOT VALLEY NEAR KAMAS CREEK, CAPACITY OF THE TRACT PICTURED, ABOUT 15,000 FEET B. M. PER ACRE

The acreage is computed on the basis of the relative percentage each area bears to the whole of each basin. Final surveys may change the acreage somewhat, especially in the portions of the reserve north of the two main Bitterroot forks and in the Little West Fork Valley.

Acreage and amount of yellow-pine timber.

| Valley. | Acres. | Feet B. M. |
|---|--------|-------------|
| Main Bitterroot..... | 6,500 | 6,500,000 |
| West Fork | 4,850 | 19,128,000 |
| Little West Fork | 6,000 | 30,400,000 |
| Little South Fork | 8,900 | 26,700,000 |
| South Fork, exclusive of tributaries above Bluejoint Creek..... | 22,000 | 88,500,000 |
| Bluejoint Creek | 1,800 | 3,000,000 |
| Slate Creek | 1,340 | 5,860,000 |
| Coal Creek | 3,200 | 19,600,000 |
| Overwhich Creek..... | 5,620 | 18,440,000 |
| Hughes Creek..... | 11,200 | 33,080,000 |
| Chicken and Wood creeks | 350 | 350,000 |
| Total | 71,760 | 251,558,000 |

RED FIR.

Acreage and amount of red-fir timber.

| Valley. | Acres. | Feet B. M. |
|---|---------|-------------|
| Main Bitterroot..... | 12,000 | 6,000,000 |
| West Fork | 8,000 | 9,600,000 |
| Little West Fork | 5,500 | 6,500,000 |
| Little South Fork | 3,500 | 7,000,000 |
| South Fork, exclusive of tributaries above Bluejoint Creek..... | 65,000 | 130,000,000 |
| Bluejoint Creek | 1,200 | 1,200,000 |
| Slate Creek | 2,000 | 1,000,000 |
| Coal Creek | 3,000 | 4,500,000 |
| Overwhich Creek | 16,700 | 58,430,000 |
| Hughes Creek | 25,000 | 65,000,000 |
| Chicken and Wood creeks | 2,000 | 2,400,000 |
| Total..... | 143,900 | 291,630,000 |

The areas included in the foregoing estimates are those that have not been logged systematically. To them should be added the remnants of the forest yet standing upon various culled tracts, as follows:

Timber standing on culled tracts.

| Basin. | Acres. | Feet B. M. |
|-------------------------|--------|--------------|
| West Fork | 2, 400 | 3, 600, 000 |
| Little West Fork | 5, 000 | 6, 000, 000 |
| South Fork | 1, 200 | 1, 500, 000 |
| Little South Fork | 160 | 160, 000 |
| Total | 8, 760 | 11, 260, 000 |

Of this amount about two-thirds, or 7,506,000 feet, is red fir; the rest is pine, composed principally of crooked and deformed trees not considered fit for logging purposes when the balance was removed. Occasional trees of the Engelmann spruce are found mixed with the red fir, especially in the low, wet valleys. The tree occurs in such insignificant amounts that it has not been deemed necessary to separate it. What there is of it is included in the estimates of hemlock-spruce.

Recapitulation of estimates of standing timber in the yellow-pine zone.

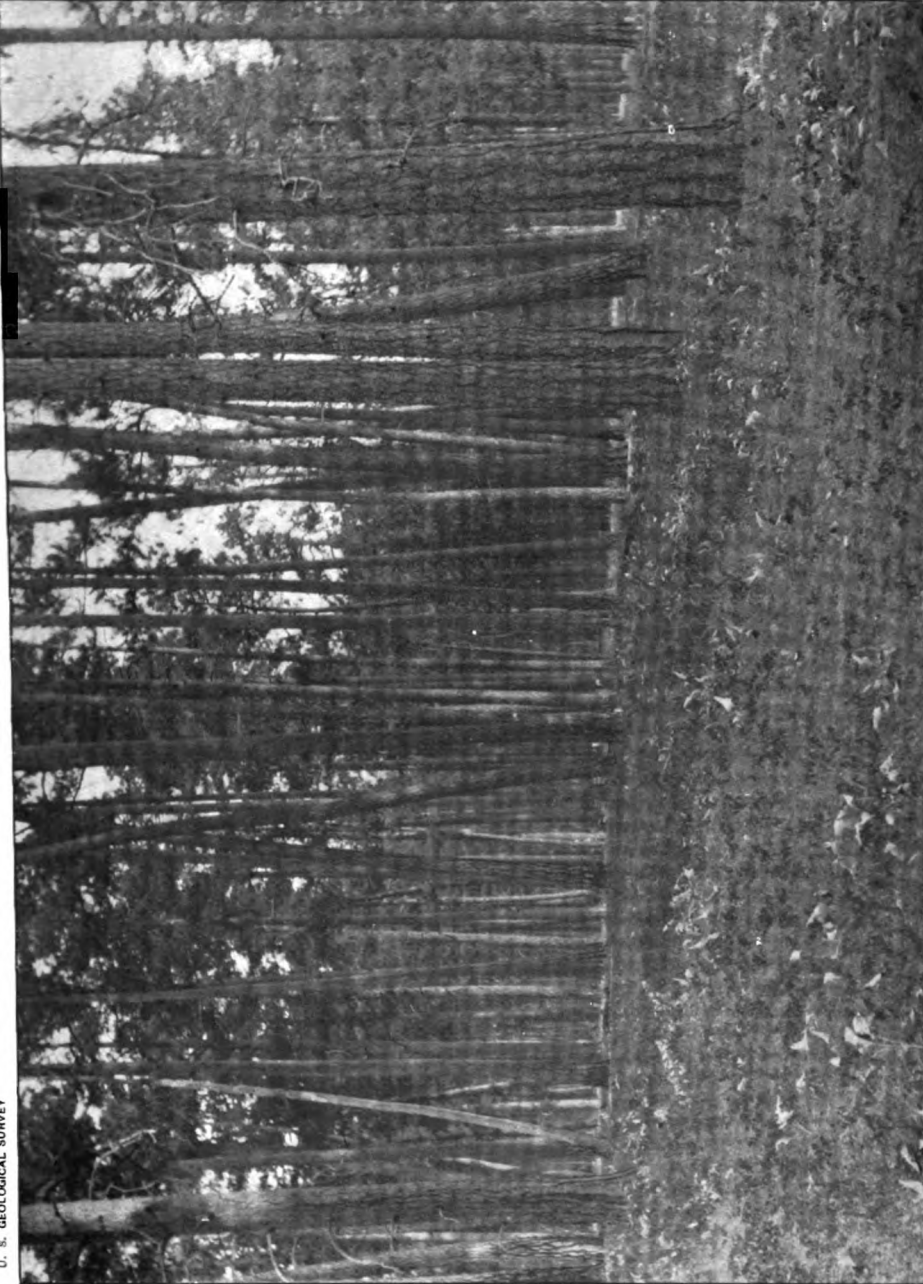
| Kind of timber. | Acres. | Feet B. M. |
|-------------------------|----------|---------------|
| Yellow pine on | 80, 520 | 255, 312, 000 |
| Hemlock-spruce on | 152, 660 | 299, 136, 000 |
| | | 554, 448, 000 |

In the above estimates the areas with yellow pine and red fir overlap. Separated, the acreage is estimated to stand as follows:

| | Acres. |
|--------------------------------------|----------|
| Yellow pine, pure growth | 30, 140 |
| Yellow pine and hemlock spruce | 92, 300 |
| Hemlock-spruce, pure growth | 67, 000 |
| Total | 189, 440 |

The last number represents the area now producing merchantable timber in the yellow pine zone.

The tracts in the western portion of the Bitterroot Valley, outside the reserve, which produce merchantable timber, are chiefly within the section from Roaring Lion to Trapper Creek. This area carries an exceptionally heavy body of timber, in general of better quality than elsewhere in the western section of the basin. The acreage of the



YELLOW PINE FOREST IN THE BITTERROOT VALLEY BETWEEN KAMAS AND LOST HORSE CANYONS; CAPACITY OF THE TRACT
PICTURED, ABOUT 30 000 FEET B. M. PER ACRE.

tract is about 95,800 acres, of which about 65,000 acres are bench lands and 30,800 mountain slopes. The bench lands average about 6,000 feet per acre and the hill slopes about 2,500 feet of all kinds of timber above 16 inches diameter at the base. Occasional tracts on the terraces will scale as high as 30,000 feet per acre, but they are exceptions, and the foregoing estimates are believed to be substantially correct. The totals would be as follows:

| | Feet. |
|--|-------------|
| 65,000 acres, average 6,000 feet | 390,000,000 |
| 30,800 acres, average 2,500 feet | 77,000,000 |
| Total | 467,000,000 |

The bulk of this is yellow pine; less than 2 per cent, or 9,340,000 feet. B. M., is red fir.

Most of the land in this tract has been surveyed and passed into the hands of private owners long since, but there is yet a strip of 25,000 acres or more, lying along and on the lower slopes of the mountains, with some bench land near Trapper Creek, neither surveyed nor sold, and the east line of the reserve should be shifted far enough eastward to cover it. Below Roaring Lion Creek the valley and the accessible slopes abutting on it have long been culled of the merchantable timber, except some small tracts held by private owners, in the aggregate an inconsiderable amount.

The timber in the subalpine zone is not of merchantable quality, and is not accessible. Its chief value lies in its capacity, while in the growing state, as a regulator of the water flow at the sources of the streams.

TIMBER CUTTING.

The character of the timber cutting up to date falls under three heads:

1. Cutting by squatters to improve their holdings.
2. Cutting by pretended squatters who held the land temporarily while logging it, and afterwards abandoned their claims.
3. Cutting under timber permits granted by the Secretary of the Interior.

The cuttings under the first class form the smallest and those under the third class the largest part of the total, while those under the second are intermediate. The migratory squatters that constituted the second class depended for the sale of the logs chiefly on the loggers operating under permits, though usually, as a matter of common report, the holders of the timber-cutting permits simply paid the squatters a lump sum for the privilege of cutting over their holdings. The logging under the permits was carried on by the Bitterroot Development Company, and the crops of logs were converted into lumber at their sawmill in Hamilton, in the Bitterroot Valley. Their operations have extended throughout the timber in the more accessible portions of the Bitterroot

Valley, with the exception of the South Fork Basin above Rambo Flat. Within the reserve they have cut over the following areas:

| | Acres. |
|--------------------------------------|--------|
| Valley of the West Fork | 1, 800 |
| Valley of the Little West Fork..... | 2, 600 |
| Valley of the Little South Fork..... | 200 |
| Valley of the main South Fork..... | 1, 900 |
| | 6, 500 |

The cutting upon these tracts varies from total, or nearly so, in the valley trough and on adjacent bench lands, to 20 per cent on tracts farther removed. In addition to the acreage included in the estimate, small tracts of a few acres each have been culled from 10 to 50 per cent. They are scattered along the forest in various places, and probably foot up 1,200 or 1,500 acres. It is impossible to ascertain the exact quantity cut from these lands, as nothing is left to show the average height of the trees that were felled. Estimating by the adjacent unlogged forest, and allowing for a somewhat greater height of the timber in the valley trough than on the hillsides, it may be assumed that the cut amounted to about 50,000,000 feet B. M., in round numbers. The cutting was accompanied by a great deal of unnecessary waste. Only the choice portions of the logs were taken. Trees were felled carelessly, breaking and splintering adjacent ones. Trees were felled, sawed up into proper logging lengths, and left to rot. Logs were hauled together in piles for banking and abandoned. In no case were the tops disposed of, and they litter the ground in all directions with a vast mass of inflammable material.

Outside the reserve, logging operations have been carried on everywhere throughout the valley. Below Grantsdale fully 90 per cent of the accessible merchantable timber has been cut. Above that point there has been considerable cutting at the mouth of Lost Horse Creek, amounting to 75 or 80 per cent over areas aggregating, perhaps, 5,000 acres. Most of the valley of Tincup Creek has been logged clean of yellow pine, and the valley of the West Fork, from its junction with the East Fork to the reserve line, is logged off clean in the trough, and from 20 to 95 per cent on the slopes. In the heavy body of timber between Lost Horse and the West Fork, cutting has been done on many small tracts along the edges and in the interior, some by settlers taking up agricultural claims and some by migratory squatters. Most of the lands here are now owned by parties that have purchased under the Timber and Stone Act and are husbanding the standing timber against the day of scarcity. The disposal of these lands under the Timber and Stone Act furnishes good arguments for the repeal of that act. The lands were originally purchased by individuals who, upon acquiring ownership, immediately transferred their holdings to lumber corporations. It is a matter of common report that the purchase money was supplied by these same corporations, and a bonus besides to cover the value of the individual's purchasing right under the law. Although

sold under the Timber and Stone Act, it is a patent fact that there are many tracts which are as good agricultural lands, when the timber is removed, as any in this section of the Bitterroot Valley. The legal price (\$2.50 per acre) at which the lands were sold was ridiculously low. There are large tracts averaging from 10,000 to 20,000 feet of merchantable timber per acre, or as much as 3,200,000 feet to a quarter section. Even at a stumpage of no more than 50 cents per thousand, a tract of the latter class would have a value of \$1,600. But, in fact, timber so easily accessible is worth now about \$3 per thousand, or \$9,600 for the amount on a quarter section of this character, and when the land is fit for agricultural purposes, upon removal of the timber, about \$800 more. Yet such lands have been sold for the sum of \$2.50 per acre.

The merchantable timber in the Bitterroot Valley will not last many years at the present rate of consumption. The yellow pine within the reserve could, with ease, be logged off in five years. At a similar pace it is safe to say that less than twenty years would see all the accessible merchantable pine in the valley converted into logs or lumber.

The merchantable timber in the reserve is comparatively easy of access, and can all readily be logged. The canyons from the West Fork northward usually have a spring freshet high enough to float logs into the main river, and are mostly clear enough from bowlders to permit driving as far up as the yellow pine extends. The West Fork, Little West Fork, Little South Fork, and the main South Fork all have deep enough water in the spring to drive on.

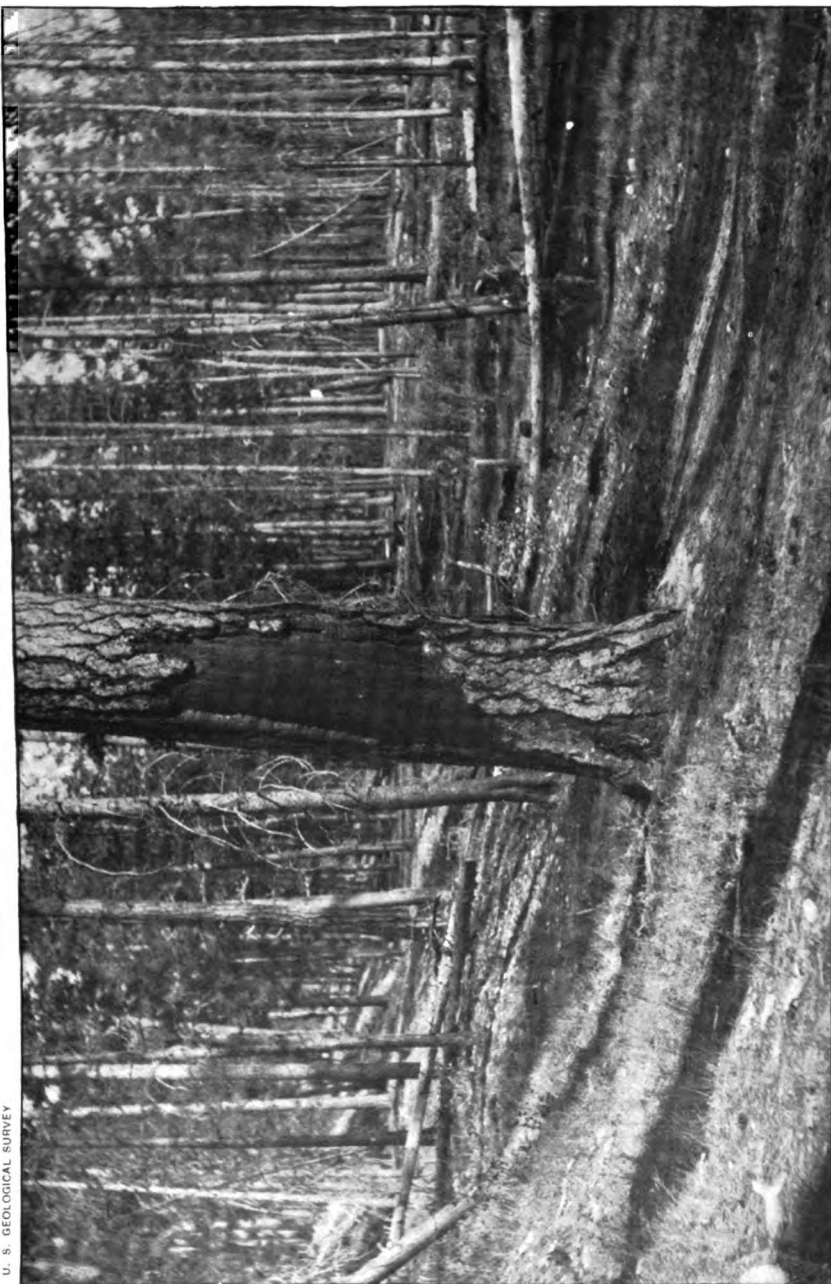
FOREST FIRES.

The fires in the Bitterroot Basin have been as extensive as elsewhere in the West, but have done far less damage to the merchantable timber. This is due to the resistance offered by the yellow pine and to the small quantity of litter and humus in the forest. The ground in this kind of growth is always covered with a thin layer of pine needles—never a proper humus—and is usually free from undergrowth, or has but a minimum. Grasses or sedges in bunches cover the ground thinly, hardly ever forming a continuous sod. In consequence fire runs through the forest rapidly. While, therefore, the yellow pine has a better chance to escape destruction than most of the other western conifers, yet it yields to repeated fires and is eventually consumed. Its vulnerable point is just at the base, where there is always an accumulation of flakes of bark thrown off, which contain more or less resin. As the fire runs through the thin grass growth it finds more than a temporary lodging place in the accumulated bark debris, and a hotter fire is the result. A point of entrance to the interior of the tree is afforded by resin lumps on the trunk, which mark the former point of attachment of cast-off branches. The fire catches in the resin lump, burns into the tree, and is finally extinguished in the sappy wood of the interior, but

not before it has created a fresh wound, which is soon covered with an exudation of resin and furnishes a larger burning surface for the next fire. The resinous-wood patch grows larger with each recurring fire, until the tree finally yields and is entirely consumed, or so weakened that the first heavy wind breaks it off.

The fire sears on the yellow pine are extremely common in the Bitterroot Basin. In the valley of the West Fork and Little West Fork more than 30 per cent of the pine has sears extending from 2 to 8 feet from the ground and varying in depth from a mere bark burn to 6 or 8 inches. At the mouth of Hughes Creek in the main South Fork Basin there is scarcely a tree over a tract of 1,200 acres that has not a big sear, rendering from 5 to 10 per cent of the tree worthless. The greatest damage from fire among the merchantable-timber species occurs in the pure red-fir areas. Growing mostly on northern slopes or in moist valleys, an appreciable quantity of humus has collected, and fire is in consequence more destructive.

Comparatively little of the pure yellow-pine or the mixed yellow-pine and red-fir growths has been destroyed, probably not more than 5 per cent, or about 10,000 acres of the entire zone. The destruction has been greatest in the pure, or nearly pure, red-fir forest, where we estimate that upon more than 50,000 acres the forest has been destroyed from 60 per cent to total. The burnt areas are found principally on the slopes facing north in the valleys of the West Fork, Little West Fork, and Little South Fork. The destruction in the latter has been much the greatest. Almost the entire slope of the valley south of the stream from its junction to its head has been burned over within the last thirty-five or forty years, and considerable tracts have been subjected to two consecutive fires within that period, completely denuding them. The slopes in the South Fork Valley facing the east and the region about its head above Mineral Point have been much devastated in later years. During the present summer the fires destroyed a large amount of red fir in the middle sections of Hughes Creek, burning over some 1,500 to 2,000 acres. It is in the subalpine zone, however, that the fires have been the most widespread. Fully 80 per cent of the wooded portions of the zone have been visited by fires within the last twenty-five or thirty years. By far the most extensive burns date back only ten or fifteen years. From Big Hole Pass to the ultimate head of the Little West Fork nearly every forested area at the head of the streams has been more or less burned. At the head of the Little West Fork, the Little South Fork, and the tributaries coming from the west into the main South Fork the lodgepole-pine forest is almost totally destroyed. The same conditions prevail along the divide and the upper slopes between the East Fork and the South Fork. More than 50 per cent of the lodgepole pine on the spurs facing the Bitterroot Valley below the main forks has shared the same fate. The destruction in the lodgepole-pine areas has been far more com-



FIRE SCAR ON A YELLOW-PINE TREE NEAR THE MOUTH OF OVERWHICH CREEK, ILLUSTRATING HOW FOREST FIRES DESTROY THIS SPECIES.

plete than elsewhere, owing to its greater density and more abundant litter. The causes of the fires are the same here as elsewhere. Hunters and trappers, prospectors and travelers, in the past have not exercised the least care in the matter of their camp fires. The largest burns are adjacent to the valleys of the Little South Fork and the main South Fork. Through the former runs a highway connecting the Bitterroot basins with those of the Clearwater—the Nez Percés trail—and along the latter are clustered most of the known mineral deposits in the region.

In comparison with the amount of standing timber, merchantable and otherwise, the fire damage during the last forty years may be thus summarized, roughly:

| | Per cent. |
|---|-----------|
| Pure yellow-pine growth..... | 1 |
| Mixed yellow-pine and red-fir growth..... | 4 |
| Pure red-fir growth..... | 50 |
| Lodgepole-pine growth..... | 80 |

Expressed in feet the loss would probably stand approximately as follows:

| | Feet B. M. |
|---|---------------|
| Pure yellow-pine growth..... | 2, 553, 120 |
| Mixed yellow-pine and red-fir growth..... | 5, 411, 840 |
| Pure red-fir growth..... | 130, 000, 000 |
| Total..... | 137, 964, 960 |

From the *present* commercial standpoint with reference to lumber values in the Bitterroot Basin no damage has resulted from burning the lodgepole pine and but little from the destruction of the red fir.

It is clearly evident that within the last four or five years the fires have decreased in frequency and extent. There is a general and laudable public sentiment in the valley adverse to fire setting, in great contrast to the indifference prevailing elsewhere in the West. Through the efforts of the Anaconda Copper Mining Company posters, with extracts from the Montana State laws relative to fire setting and the penalties attached, have been pretty generally distributed through the valley and are found tacked up at all the usual camping places and along the traveled trails. But aside from this, the people are of themselves beginning to realize that the growing timber is a factor in the wealth of the community easy of exhaustion and slow of restoration, and the drift of sentiment is therefore decidedly hostile to forest fires and their originators.

The damage consequent upon fires in the yellow-pine stands has consisted not only of the fire sears already described but, of greater moment, the check on the reproduction of the species. The absence or comparative scarcity of young trees from 5 to 20 years old is very striking, even where the forest is, to all appearances, the best preserved. On the pure

red-fir areas the burnt tracts are rapidly being reforested, with the original species as the preponderating growth. The lodgepole pine and, in general, all the burnt subalpine tracts, are reforesting but slowly, and when the lodgepole pine has been burned twice in succession, not at all. In the reforesting process it usually comes again as the first growth, and shows everywhere a tendency to encroach on the territory occupied by the other species of the zone.

The people living in the upper portion of the valley have become aware of the fact that since the lodgepole-pine regions were so extensively burned the spring freshets are greater and the stream channels in the canyons are constantly widening. This is perfectly in accordance with conditions that are manifesting themselves in other sections similarly situated with reference to drainage and forest destruction. The sentiment consequently is strongly in favor of the rigid exclusion of forest fires from the lodgepole-pine region in the future, notwithstanding the valueless character of the tree with reference to the lumber supply it affords.

TABLES.

BITTERROOT RESERVE IN MONTANA.

AGRICULTURAL LANDS.

The agricultural lands are situated in the valleys of the South Fork, Little South Fork, Little West Fork, and West Fork, and consist of—

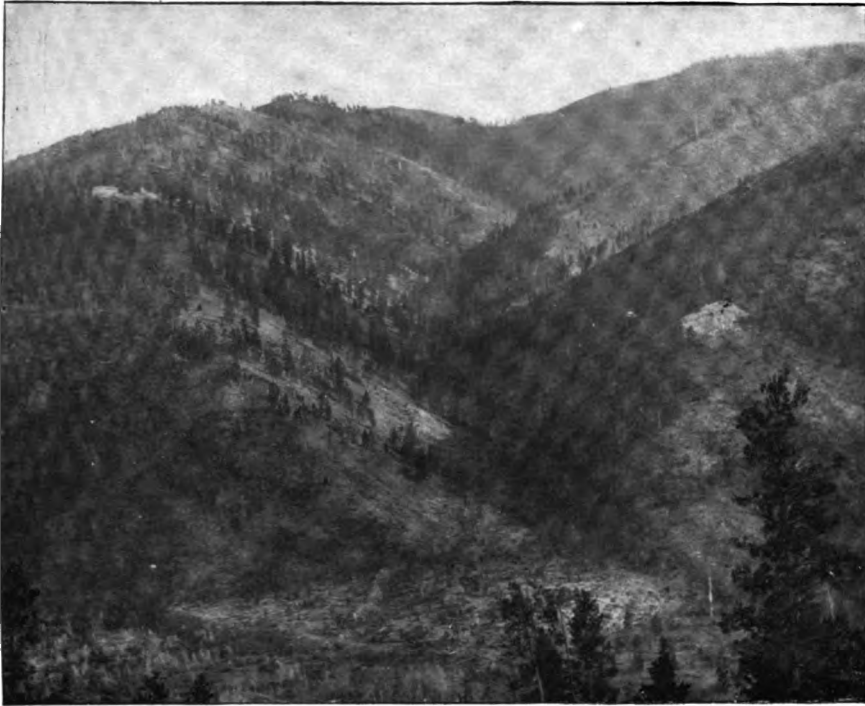
1. Lands on which the timber has long been cut and removed and which are now under the plow.
2. Areas along streams with a more or less dense covering of brush, willows, or coarse sedges, with occasional small tracts brought under the plow. Their aggregate acreage and distribution are as follows:

Agricultural lands in class 1.

| | Acres. |
|------------------------|--------|
| Little West Fork | 45 |
| West Fork | 10 |
| Total | 55 |

Agricultural lands in class 2.

| | Acres. |
|---|--------|
| In upper half of Little South Fork Valley | 200 |
| In South Fork Valley below and including Rambo Flat | 150 |
| In South Fork Valley from Slate Creek to Overwhich | 250 |
| In South Fork Valley between Overwhich and Hughes Creek | 150 |
| In Overwhich Creek | 120 |
| In Hughes Creek | 350 |
| In Wood and Chicken creeks | 100 |
| In South Fork Valley at Mineral Point | 120 |
| Total | 1,440 |



A BURNT RED-FIR AREAS IN THE WEST FORK VALLEY.



B. ALPINE LAKELET NEAR THE HEAD OF ONE OF THE BEAR CREEK TRIBUTARIES; MAIN RANGE OF THE BITTERROOT MOUNTAINS IN THE BACKGROUND.

Agricultural lands under cultivation in class 2.¹

| | Acres. |
|--|--------|
| In South Fork Valley below Overwhich..... | 5 |
| In South Fork Valley at Overwhich | 20 |
| In South Fork Valley above Overwhich | 2 |
| Total | 27 |

Total agricultural lands.

| | Acres. |
|--|--------|
| Little West Fork and main West Fork basins..... | 55 |
| Little South Fork and main South Fork basins | 1,440 |
| Total | 1,495 |

Total agricultural lands under cultivation.

| | Acres. |
|--|--------|
| Little West Fork and main West Fork basins..... | 55 |
| Main South Fork and Little South Fork basins | 27 |
| Total | 82 |

ACREAGE OF FOREST ZONES.

Approximate acreage of the forest zones.

I. ZONE OF THE YELLOW PINE.

| | Acres. |
|---|---------|
| Bitterroot Valley to Trapper Creek..... | 19,200 |
| Upper portion of West Fork Basin | 12,160 |
| Little West Fork Basin | 14,880 |
| Little South Fork Basin | 25,344 |
| South Fork Basin | 132,352 |
| East Fork Basin | 1,152 |
| Total | 205,088 |

II. ZONE OF THE SUBALPINE FIR.

| | Acres. |
|---|---------|
| Bitterroot Valley to Trapper Creek..... | 236,800 |
| Upper portion of West Fork Basin..... | 48,640 |
| Little West Fork Basin | 84,320 |
| Little South Fork Basin | 32,256 |
| South Fork Basin..... | 168,448 |
| East Fork Basin | 11,648 |
| Total | 582,112 |

SPECIES OF TREES.

Species of trees composing the forest zones.

I. ZONE OF THE YELLOW PINE.

| | |
|---------------------|-------------------------------|
| Yellow pine..... | <i>Pinus ponderosa.</i> |
| Lodgepole pine..... | <i>P. murrayana.</i> |
| Red-fir..... | <i>Pseudotsuga mucronata.</i> |
| White fir | <i>Abies grandis.</i> |
| Balm | <i>Populus balsamifera.</i> |
| Aspen | <i>P. tremuloides.</i> |
| Birch..... | <i>Betula occidentalis.</i> |

¹ In several small patches.

FOREST RESERVES.

II. ZONE OF THE SUBALPINE FIR.

| | |
|------------------------|---------------------------|
| Lyall tamarack | <i>Larix lyallii</i> . |
| Subalpine fir | <i>Abies lasiocarpa</i> . |
| Lodgepole pine | <i>Pinus murrayana</i> . |
| White-bark pine | <i>P. albicaulis</i> . |
| Engelmann spruce | <i>Picea engelmanni</i> . |
| Yew | <i>Taxus brevifolia</i> . |

Proportion of species composing the zones.

I. YELLOW-PINE ZONE.

| | Approx. per cent. |
|--|----------------------|
| Yellow pine | 30 |
| Lodgepole pine | 6 |
| Red fir | 60 |
| White fir | 2 |
| Balm | } Trifling. |
| Aspen | |
| Other species, semi-arborescent willows and alders | |
| | 100 |

II. SUBALPINE-FIR ZONE.

| | Approx. per cent. |
|--|----------------------|
| Subalpine fir | 5 |
| Lodgepole pine | 90 |
| White-bark pine | 2 |
| White fir | } Trifling. |
| Lyall tamarack | |
| Engelmann spruce | |
| Yew and semi-arborescent willows | |
| | 100 |

Estimates based on basal diameters of 4 inches.

Range in size and age of trees.

I. YELLOW-PINE ZONE.

| Species. | Height. | Diameter. | Clear trunks. | Age. |
|----------------------|--------------|----------------|---------------|---------------|
| | <i>Feet.</i> | <i>Inches.</i> | <i>Feet.</i> | <i>Years.</i> |
| Yellow pine | 70 to 150 | 15 to 40 | 15 to 75 | 80 to 275 |
| Lodgepole pine | 40 to 90 | 8 to 14 | 10 to 45 | 50 to 100 |
| Red fir | 25 to 100 | 8 to 20 | 5 to 35 | 50 to 150 |
| White fir | 20 to 150 | 6 to 36 | 0 to 20 | 40 to 200 |

II. SUBALPINE ZONE.

| | | | | |
|------------------------|-----------|---------|---------|-----------|
| Lyall tamarack | 30 to 75 | 6 to 48 | 0 to 30 | 70 to 400 |
| Subalpine fir | 50 to 90 | 6 to 18 | 0 to 15 | 40 to 90 |
| Lodgepole pine | 50 to 90 | 3 to 14 | 0 to 20 | 20 to 100 |
| White-bark pine | 30 to 50 | 6 to 30 | 0 to 20 | 60 to 300 |
| White fir | 30 to 60 | 4 to 12 | 0 to 15 | 20 to 70 |
| Engelmann spruce | 40 to 100 | 6 to 20 | 0 to 30 | 30 to 200 |

AMOUNT OF TIMBER.

Estimated amount of merchantable standing timber.

I. YELLOW PINE.

| Drainage area. | Acres. | Amount. |
|--|--------|-------------------|
| | | <i>Feet B. M.</i> |
| Main Bitterroot Valley | 6,500 | 6,500,000 |
| West Fork Valley | 4,850 | 19,128,000 |
| Little West Fork Valley | 6,000 | 30,400,000 |
| Little South Fork Valley | 8,900 | 26,700,000 |
| South Fork Valley, exclusive of tributaries above Bluejoint Creek | 22,000 | 88,500,000 |
| Bluejoint Basin | 1,800 | 3,000,000 |
| Slate Creek Basin | 1,340 | 5,860,000 |
| Coal Creek Basin | 3,200 | 19,600,000 |
| Overwhich Basin | 5,620 | 18,440,000 |
| Hughes Basin | 11,200 | 33,080,000 |
| Chicken and Wood basins | 350 | 350,000 |
| Total | 71,760 | 251,558,000 |

This gives an average of about 3,505.5 feet B. M. per acre.

These estimates are made up from the aggregates of many small parcels in the various basins, running all the way from 1,000 to 8,000 feet per acre, and are on a basis of 16 inches diameter at the base.

The red fir, as it grows in the Bitterroot Basin, can not strictly be considered as merchantable timber, owing to deficient development of trunk. More than 80 per cent included in the estimates are below 14 inches basal diameter.

II. RED FIR.

| Drainage area. | Acres. | Amount. |
|--|---------|-------------------|
| | | <i>Feet B. M.</i> |
| Main Bitterroot Valley | 12,000 | 6,000,000 |
| West Fork Valley | 8,000 | 9,600,000 |
| Little West Fork Valley | 5,500 | 6,500,000 |
| Little South Fork Valley | 3,500 | 7,000,000 |
| South Fork Valley, exclusive of tributaries above Bluejoint | 65,000 | 130,000,000 |
| Bluejoint | 1,200 | 1,200,000 |
| Slate Creek | 2,000 | 1,000,000 |
| Coal Creek | 3,000 | 4,500,000 |
| Overwhich | 16,700 | 58,430,000 |
| Hughes Creek | 25,000 | 65,000,000 |
| Chicken and Wood creeks | 2,000 | 2,400,000 |
| Total | 143,900 | 291,630,000 |

In these estimates are included trees with diameters down to 8 inches at the butt. Trees with clear trunks are uncommon except in the lowest valleys.

Estimate of acreage of culled and logged areas, with the amount of standing timber.

| Valley. | Acres. | Amount. |
|-------------------------|--------|-------------------|
| | | <i>Feet B. M.</i> |
| West Fork | 2, 400 | 3, 600, 000 |
| South Fork | 1, 200 | 1, 500, 000 |
| Little West Fork | 5, 000 | 6, 000, 000 |
| Little South Fork | 160 | 160, 000 |
| Total | 8, 760 | 11, 260, 000 |

Red fir constitutes about 66 per cent, or 7,506,000 feet, mostly under 14 inches basal diameter; the balance is pine, largely made up of crooked or otherwise defective trees.

Summary of estimates of standing merchantable timber in the yellow-pine zone.

| | Acres. | Amount. |
|----------------------|----------|-------------------|
| | | <i>Feet B. M.</i> |
| Yellow pine on | 80, 529 | 255, 312, 000 |
| Red fir on | 152, 660 | 299, 136, 000 |
| | | 554, 448, 000 |

In this estimate the yellow-pine and red fir areas overlap. Separated, the acreage is estimated to stand as follows:

| | Acres. |
|---------------------------------------|----------|
| Yellow pine, nearly pure growth | 30, 140 |
| Yellow pine and red fir | 92, 300 |
| Red fir, nearly pure growth | 67, 000 |
| Total | 189, 440 |

This represents the area now producing merchantable timber in the yellow-pine zone of the Bitterroot Forest Reserve in Montana.

